Application of the Six Sigma methodology in customer complaints management

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Application of the Six Sigma methodology in customer complaints management: a case study in the automotive industry

Abstract
An investigation was made to identify the variables influencing the customer complaint treatment process throughout a case study in the automotive industry. Customer satisfaction is vital for an organization, but to put in practice solutions to improve it is not obvious. This investigation studied the quickness and quality of the investigations made to reply to the customer complaints, using the 8D method. This work presents a case study about the use of the Six Sigma methodology to manage and improve customer complaints’ management process. The Six Sigma methodology provides an organized structure for problem analysis and problem solving. Throughout the DMAIC phases the problem was defined; the variables influencing the process were measured; the causes for the process failure were analyzed; improvements were planned and made and the variables were controlled until a defined six sigma level and a solid level of customer satisfaction were reached. The reduced variability in the 8D process was achieved by integrating and managing the quality data in an integrated management system. Reorganization of tasks and methods resulted in faster reaction to complaints and problems, reducing and preventing them from recurring, representing cost savings whenever a complaint appears.

KEYWORDS: Complaint, Customer Satisfaction, Six Sigma, 8D, Integrated Management System.
1. Introduction

1.1 Customer satisfaction and dissatisfaction

Customer satisfaction and dissatisfaction are relatively new areas of research, appearing in the early 1970s (Andreassen, 1999). Understanding that complaints are an important output of business, researchers are working in order to create a better fulfillment of the complaint treatment process. A definition of “complaint treatment” by Dee et al., (2004) is: “A process that addresses issues that concern customers”. Other authors take a further look at management of complaints, defining it as: “Fixing the policies, systems, or protocols so that the problem would not occur for future customers” (Stichler and Schumacher, 2003). Complaint satisfaction is also interesting within the complaints handling research, since to implement a system to handle complaints is no longer enough (Davidow, 2003). Such system must guarantee complaint satisfaction and customer retention (Stauss and Schoeler, 2004). An earlier study made by Dingermans (1996) indicates that customers unsatisfied with complaint resolution tend to tell at least twice as many people comparing to customers satisfied with their complaint’s handling. Etzel and Silverman (1981) define complaint satisfaction as the satisfaction of a complainant with a company’s response to his/her complaint. They call this phenomenon “complaint response satisfaction”; Blodgett (1992) speaks of “satisfaction with organization complaint response”. Other researchers speak of “satisfaction with complaint resolution” (Andreassen, 1999), “redress satisfaction/dissatisfaction” (Dellande, 1995), “service recovery satisfaction” (de Ruyter and Wetzels, 2000) or “recovery disorganization” (McCollough et al., 2000). In all cases, the meaning is equivalent complaint dis/satisfaction and relationship dis/satisfaction. Transaction dis/satisfaction is the dis/satisfaction with a service or specific product acquired or consumed by a customer. If a customer complaints, a failed transaction has occurred.
The customer evaluates the company’s reaction to her/his complaint in the current state of dissatisfaction with the transaction. It is also possible that the failed transaction occurs in an ongoing relationship. This implies that there is an overall evaluation of the relationship’s satisfaction, when the customer is confronted with a problematic transaction and the company’s recovery reaction. Thus, it can be assumed that the transaction’s dissatisfaction can have an impact on the updated relationship’s satisfaction (McCollough et al., 2000).

1.2 The Six Sigma

The Six Sigma methodology is one of the most structured methodologies that contribute for the organization’s development to product and services improvement. It contributes to reach, in a profitable way, the complete customer requirement’s satisfaction (Wessel and Burcher, 2004). Although Six Sigma was first introduced in manufacturing, it has expanded itself into other departments within industries and services (Pandey, 2007) and has created new opportunities of improvement inside organizations (Sanders and Hild, 2000). Six Sigma is driven by close knowledge of customer needs, data, statistical analysis, and disciplined use of facts. Six Sigma is a methodology used to improve business processes. This methodology not only shows the current state of a process including effectiveness and efficiency, but points towards an alignment with the organization’s strategy (Sanders and Hild, 2000). It has the capability of incorporating problem contention, root cause analysis, corrective actions, and prevention actions. This methodology is important for quality and business professionals, engineers, and managers around organizations (Wessel and Burcher, 2004). One of the most widely used methodologies within Six Sigma to improve processes is DMAIC, which can be described as a set of project phases: Define,
Measure, Analyze, Improve and Control. DMAIC leads a team from the problem definition and measurement throughout solution implementation linked to underlying causes, and establishes practices to make sure that solutions are controlled and maintained (Pande et.al, 2000). DMAIC should also be used if the risks of implementation are high, even if the solution might be obvious (Coronado and Antony 2002).

1.3 The 8D methodology

The 8D consists of teams working together in order to solve problems, using a structured 8 step approach to help focus on facts, instead of opinions. The 8D method is effective in developing proper actions in order to eliminate root causes and in implementing the permanent corrective actions to eliminate the root causes. There are reports of successful use of this method to deal with chronic recurring problems, mainly defects or warranty issues (Rambaud, 2006). As a whole, the 8D methodology was never intended to replace a systemic quality system. The 8Ds' objective is to face the problems and discover the weaknesses in the management systems that permitted the problem to occur in the first place. According to Rambaud (2006), the biggest abuse in the implementation of the 8D involves using the method solely as a one-page problem-reporting effort. This misuse is often further exaggerated by requiring the report to be written within 24 hours. Some steps can take a few hours, while others can take weeks. In manufacturing, many chronic problems can occur only with a unique set of conditions. Sometimes they will be present, other times will not. Extensive studies and experiments have to be conducted in order to understand the root causes. Rambaud (2006) also states that 8D reporting can be time consuming and difficult to develop and
that in order to successfully implement the 8D methodology the persons involved should receive an appropriate training.

2. Research method

To differentiate among researches it is needed to identify the question for the specific research. The research question for this investigation is: “How do the input variables in the customer complaint process influence the chosen quality characteristics?” According to Yin (1994), questions including “how” and “why” should be answered using research strategies like case studies, experiments or histories. There are different types of case studies (Yin, 2003). The explanatory kind seemed appropriate for the present research, as they seek to explain how and why some events occurred. Explanatory theories can facilitate theory testing with a rich and extensive data collection effort, including qualitative and quantitative evidence. However, they are the most difficult and the most frequently challenged (Yin, 2003).

The choice between single-case and multiple-case studies depends on the research objectives and the availability of resources. Due to resource constraints a single case study was performed. Many industries of the automotive sector use Six Sigma and 8D methodologies, thus one company of the automotive sector was selected. The company produces multimedia car systems.

After choosing the appropriate type of case study, the researcher should define the unit of analysis and define the case study protocol. The unit of analysis is associated with the kind of case to which the phenomena under study and the research problem refer, and about which data is collected and analyzed (Hussey and Hussey, 1997). It should
contribute to clarify the boundaries and scope of the study. In this research the unit of analysis is the process of customer complaints management.

In order to facilitate data collection, it was necessary to construct a case study protocol, the interview instrument for conducting the case study (Yin, 1994). It contains all the pertinent questions to be asked when investigating the company customer complaint management process. It is a major tool for increasing the reliability of case study research and is intended as a guide for the investigator in carrying out the study. The case study protocol must assure that data collection would involve converging lines of inquiry and triangulation of evidence. Within each data source there is an emphasis on depth and quality, rather than population size. Thus, a single case can add to the understanding of a phenomenon provided multiple data sources are used and over-generalization is avoided (Yin, 1994). There have been repeated calls for more qualitative case-study-based research in operations management (Silvestro and Westley, 2002), despite the clear difficulty of drawing generalized conclusions. The case study protocol included the analysis of all the organization activities affected by the customer complaints treatment process. This research proposed to identify how and why organizations manage and improve their customer complaints process, detailing the quality of the customer feedback and the delays in that process. The case study protocol will follow the DMAIC phases of the Six Sigma methodology. The use of this protocol would provide the researcher with both quantitative and qualitative data, similar to other works (McAdam and Lafferty, 2004).

The work reported here was carried out in 2009 in a Portuguese facility of a multinational manufacturer.
3. Six Sigma Project

3.1 Define

In the selected automotive company, that produces mainly multimedia systems, certain rules regarding deadlines had to be fulfilled in order to send feedback to the customer, whenever a complaint appeared, as it was agreed in the contracts. However, these rules were not being accomplished, thus decreasing customer trust and satisfaction, service quality, and company image. This non fulfillment in the response time to problem solving also increases costs associated to the poor quality of products, such as inspection costs, failure costs, warranty costs, and other costs defined in the contracts. In this organization, like others in the automotive sector, the 8D method was used to reply to customer complaints. The response time rules after receiving a complaint and the associated step in the 8D method were the following:

- Y1 - One day; step D1;
- Y2 - Two days; steps D2 and D3 completed;
- Y14 - Fourteen days; all steps until D5 completed, D6 and D7 defined;
- Y60 - Sixty days; all steps completed.

To understand the voice of the customer regarding these rules, a Kano analysis was used. Each need was classified as a “dissatisfier”, “satisfier”, or “delighter”. The response rate was 80%, much higher than previous questionnaires sent by the organization. All the customer’s replies regarding the response time rules and a good explanation of each step were classified as dissatisfiers. The efficiency rate of containment and corrective actions was rated as a dissatisfier in 80% of respondents. Ways to improve the response time and quality of the customer complaints were to be further investigated, in order to reduce costs associated to the time spent to solve problems and to the recurrence of defects.
The time needed to solve a customer complaint does not have always the same impact on cost savings. Sometimes problems originate many complaints, while others originate only a few. However, the total costs are continuously increasing over time. Estimation of the costs associated to the problem investigation is possible, but to measure the costs associated to image loss and customer dissatisfaction is a harder task. Defect recurrence costs rise whenever the same defect occurs due to a low quality or slow reactivity problem solving investigation, increasing the total warranty costs.

The total number of customers’ complaints in 2008 was 984 (543 of them were recurring complaints partially associated to the Y2 rule,). Increasing the quality and speed of problem solving investigations and feedbacks to customers, results in cost savings associated to the prevention of recurrent complaints and increases customer satisfaction by fulfilling the requirements.

### 3.2 Measure

Data already existed for the response time rules, however, in order to validate the measurement system, it would be needed to understand if all the customer assistants were measuring in the same way, i.e. if they were considering the right times for the rules defined and reporting accurate measures to the file in use to track them. By interviewing each customer assistant about their perception of the definition of each rule, opinions seemed to diverge and originate controversy among them:

*The seven customer assistants were given five 8D reports, and they were asked to analyze five random samples in two trials. Regarding Y1, no one was able to successfully associate the one day rule to the completion of D1. Some of them said that the one day was the transport time for the part to arrive at the organization’s premises, while others gave similar opinions. For Y2, it was verified also a discrepancy between the standard and appraisers. Only about 28% were able to match the requirements. Most of the incorrect answers were based in that it was just*
when the problem analysis was complete, forgetting that the containment actions were also part of the rule. Their main doubts regarding Y14 was to know if it ended by the time that the countermeasures were implemented or not. About 42% answered correctly or approximately. Y60 was the one with more correct answers. Almost all of them said that it was the final date that the 8D report had to be completed. There was one customer manager that was not aware of this requirement.

The results from this analysis demonstrate that the current measurement system was not reliable enough to guarantee an accurate measure; therefore another measurement system had to be used.

A random sample of 8D reports was chosen and the necessary data was manually taken from the different information systems. By collecting each date according to the indicator’s specifications, it would guarantee that the response time and quality evaluation would be respected.

Thus, new data was generated resulting in an average quality level of 50%. The research team defined, as a secondary objective, to reach an average of quality level for 8D reports of 70%.

A sigma value is a metric frequently used to relate the ability of a process to perform defect-free work. The higher the sigma value, the better the process is performing, thus the probability that a defect will occur will be lower. Considering one opportunity to fail in each of the four response time rules (e.g. it took 3 days to complete D2 and D3 or it took 71 days to complete an entire 8D report), then 151 defects were found in 189 opportunities, which means an initial sigma value of 0.66. The target reduction on defects per million opportunities (DPMO) was 90%.
3.3 Analyze

Brainstorming was used to gather ideas about the possible causes that lead to exceed deadlines in the customer’s complaint process. Doing a mixed approach, customer assistants stated ideas, resulting in a list of about 72 possible causes to the customer complaint process failure. Causes that were identified in the observation process were added and similar causes were verified. Individual interviews were conducted with low level of standardization and structure in order to find more specific causes. A Fishbone analysis was conducted in order to understand the cause and effect relationships of the defects regarding the response time and quality of the customer complaint treatment process. The Fishbone diagram is shown in Figure 1.

Figure 1 - Fishbone diagram for the defects (delays and quality) in the Customer complaints treatment process

To each cause identified by the interviewees and by process observation, the “5 Whys” method was used to take out the root causes affecting the process. For example:
Signature process takes a lot of time. Why? The signature process is unclear. Why? There is no standard procedure for signing the 8D reports.

A particular cause regarding the measurement system was detected during the “Measure” phase. The system itself needed constant manual input and control, as well as it was difficult for the databases to communicate between themselves, which was derived from the different languages and different data they shared. It was also hard to involve the persons external to the plant if the data was not entirely integrated and prepared for them.

3.4 Improve

Following the analysis phase, the team decided to reduce the number of defects, by focusing on improving the customer complaint management system. This could be achieved by pursuing the following objectives:

1. to have an accurate and precise measurement system;

2. to increase the communication between problem solving teams;

3. to have a standard 8D report between supplier, plant and customer;

4. to reduce waste in the reporting system;

5. to increase the quality of the problem solving investigations;

6. to keep the customers informed, providing a speedy feedback with reliable information;

7. to have a single point of contact for analyzing on-site the defects occurred at the customer;

8. to have a reporting system to check recurring complaints after problem resolution;
To accomplish these objectives a set of improvement initiatives were considered. The matrix (see Table 1) relates them with improvement actions that are described subsequently.

Table 1 – Relationship matrix between objectives and improvement actions

<table>
<thead>
<tr>
<th>Objectives</th>
<th>A1</th>
<th>A2</th>
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A1. Measurement system improvement

A measurement system that would allow the automatic measurement of the response time requirements was sought. After evaluating different possibilities, the two alternatives represented in Table 2 were considered as the most feasible.
Table 2: Pros and Cons of the improvement alternatives

<table>
<thead>
<tr>
<th>Alternative A – Create algorithm in calculus sheets</th>
<th>Alternative B – Integrate data into the ERP system</th>
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<tbody>
<tr>
<td>- Time consumption</td>
<td>+ No resources required to develop</td>
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<tr>
<td>- Software (and algorithm) development</td>
<td>- Training of the persons involved</td>
</tr>
<tr>
<td>- Qualified person required</td>
<td>+ Communication between different databases</td>
</tr>
<tr>
<td>+ Required training</td>
<td>+ Consistency of data</td>
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<tr>
<td></td>
<td>+ Interdepartmental communication improved</td>
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</table>

Alternative B was selected. In the Enterprise Resource Planning (ERP) system, all the persons involved can track the progress of the complaint and the time spent. Each one can contribute to the problem solving, this way, an increase in the awareness, know-how and participation of the persons involved can be foreseen. The control of the indicators was made by control buttons on the ERP platform. This allowed the complaints to have the respective response time measures. An analogy was made with production processes, where a part or material can only move forward when the required inputs are present, therefore making it impossible for errors to be passed to the next step. This concept of mistake proofing is many times called as Poka-Yoke. The input data was to be periodically verified by the section manager in order to find if the data inside was accurate. The interested parts were instructed to consult their complaint list daily and a reminder was also included so that the system could warn the person when the deadline was getting closer, according to the ERP workflow. The monitoring
of the response timings would be made automatically by a transaction in ERP (SAP©) that picked various dates in order to form a statistics about the indicators. The response time was measured every time, in the right time.

A2. Quality improvement

An initial quality improvement of the 8D reports was made by the measurement system itself (ERP system). Customer assistants noticed and complained about the increase on the amount of quantity of information that was necessary to put in the new system. However, the new system required the same quantity of information as the old system, since the 8D structure was completely the same. The new control system that the new measurement system had required that all the information in the 8D report had to be completed according to the rules defined and according to the quality evaluation rules. One could not advance to the next step without previously completing the step before. The customer assistants were so intrigued, because in the new system, they could not skip any steps as it was verified in the old system 8D reports where the information was many times incomplete, the investigation made was poor, and thus the quality of the 8D reports was low.

This new system would allow a quality increase of the 8D report contents. In order to control the quality of the 8D reports, the 8D evaluation sheet used in the “Measure” phase was adopted as the standard. Every 8D report would need to be completed with this evaluation sheet, represented in an automatic calculation form.

A3. Response time improvement

A3.1. Rule Y1

For the fulfillment of the first rule (Y1), one person was assigned to be associated to each customer plant. Only after confirming the defect and providing an initial problem analysis he or she could decide on what to do with the part: to take it for investigation;
to send it for repair; to scrap it. A faster problem analysis and faster containment actions at the customer and at the organization’s plant were achieved. In some cases, this person saw in the system if this was a recurrent defect or a defect which was already under investigation and he or she could choose not to send the defect part to the plant for investigation, therefore reducing warranty costs. This is an example of the use of the reporting system, in some cases called “lessons learned” process. In case of sending the part for investigation, this person opened a complaint in the ERP system in order to provide information about the problem and automatically notify the defined team in the production plant so that they could start analyzing the problem and providing containment actions even while the part was still in transport, reducing the time to start solving the problem.

A3.2. Rule Y2

The interdepartmental and intradepartmental lack of communication problem, partially associated to the Y2 rule, was approached with the placement of a form in the company’s intranet to plan the occupation of the internal and external laboratories by the team requesting the analysis of the defect part, thus eliminating the variation in the waiting times and allowing a specific completion date to be set.

An approach was used to eliminate delays for complaints under specification (i.e. no trouble found after the analysis of the device) and customer complaints. In case of deciding a defect part was under specification, further analysis could be made by the development together with the customer in order to find the causes which originated the initial complaint. In this case, special agreements were to be made with the customer. In case of deciding upon customer fault regarding a compliant, the organization should strive to help the customer, so the investigation should continue, but both the team and customer should reach an agreement regarding the closure of the 8D report after the Y2
rule. In under specification or customer fault cases, both complaints do not need an associated 8D report, because corrective actions, for instance are not applicable at the plant. Therefore, 8D reports for these cases were abolished. In the system the complaint can be closed after the investigation on problem analysis was completed.

**A3.3. Rule Y14**

The adoption of ERP to fill in 8D reports made possible for the different modules in the Quality department to interact between them allowing the share and transfer of information. Unlike the past system, only one 8D report format was to be used inside and outside the company, standardizing the 8D reports, reducing time to convert between supplier and organization or between organization and customer, which often raised incoherencies and lack of data.

Whenever talking about process related issues, responsibility was given to the person in each production line with the task of line quality controller to fill in the 8D reports and to fulfill the Y14 rule. With this change, the know-how regarding problem solving was copied to the “gemba”. By sharing responsibilities in filling in the 8D reports by defect location (process, supplier, transport, customer), each of the persons directly involved in the 8D fill-in (logistics, purchase quality, production, person at the customer’s plant) would have the responsibility to fulfill each of the 8D steps on time, increasing the awareness of problem solving within the plant.

**A3.4. Rule Y60**

The 60 days rule was dependent of the time spent on the other rules. There were, however, some specific problems related to the closure of the 8D report like the signature process, where a signature was needed by the customer assistance section leader, the quality director and the plant director. By automating this procedure in ERP, a notification was sent to each one to check the submitted 8D report in the system and
give a digital signature or sending the 8D report back to the responsible person with comments to edit it if necessary. This ended with the waste on physical transport time of the documents, prevented paper waste and made the reports available to be checked and signed online anytime.

3.5 Control

An initial observation was made to see if the actions were taking progress. It was analyzed that there was an initial increase in the response time due to the training and adaptation of the persons involved. After identification and elimination of special causes affecting the process, a random sample of 8D reports of the same size as in the “Measure” phase was taken and no defects were found, which means all the response time values became under the specified rules. If one failure would have occurred, it would have represented a sigma value of 4.06. For the same data taken to analyze the response time, the quality of the 8D reports was measured and the mean observed was 70%.

Analyzing complaints from 2008, it was verified that it could have been possible to save at least 44% of the recurrent complaints only by providing a speedy response, because they were directly associated to the original complaints and could have been prevented by achieving the initial objectives for the response time. For the remaining 66% complaints it was not be possible to estimate if they could have been avoided or not with this improvement project, because some of them appeared at the same time of the initial complaint, while in others the defect was known, but the customer still complained because he/she was not sure if the complaint was originated from the same defect or not.
4. Conclusions

The results achieved were improved profitability by reduction of costs and thus enhancing organization’s competitiveness. The authors argue that customer loyalty is expected to improve as a direct result of providing a service according to contracts’ requirements.

Decision making of the persons involved was also improved and an effective use of resources was made. The improvement processes were made more efficient throughout a reply in the right time with the right information, with the right system. Six Sigma changed and clarified the role of each person involved in the customer complaints process. It also saved financial costs with the reduction of complaints. Six Sigma focused on changing what employees did and put a major emphasis on tying process improvements to customer needs.

For the following years, this improvement project can represent savings of thousands or millions, depending of the number of complaints. It is, however, certain that complaint reoccurrence will continue to happen until the process is optimized to a level of whenever a complaint happens, the solution is immediately identified and provided, resulting in the prevention of all problems, therefore complaints, which turns to be the perfect quality level. The continuous improving inside this field of research would culminate in a complaint reduction by an efficient and repeatable problem solving process, which represents savings affecting the whole structure of the organization.

Despite the initial low Sigma level, the adoption of a Six Sigma project was necessary to reinforce the top management support for this project and to allocate a team with the necessary knowledge to carry out this improvement project.
Even though one case study is not a motive to generalize, the authors argue that the Six Sigma methodology can be applied to other types of complaints and organizations. More case studies may be useful for drawing lessons for greater generalization. Future research may have better possibilities to generate grounded theory research in this field. The challenge before academics and practitioners is to address these issues in future research. Delivery and design of training programs should be systemically merged with voice of customers. Six Sigma is not one-time implementation mechanism but an ongoing management choice to deploy relevant projects. Management should have strategic and proactive orientation and should be continuously in touch with the voice of customers, benchmarking, evaluation of training programs and root cause analysis; for enhancing the efficiency and effectiveness of the complaint treatment process.

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